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The Absolute Beneath the Relative: Reflections on Einstein's Theories

EINSTEIN'S WORK ON relativity was not yet completed when it began to be taken for the scientific proof of the view that everything is relative. Such a view, widely entertained on the popular as well as on the academic level, is now a climate of thought. A stunning proof of this is a full-page advertisement in the September 24, 1979, issue of *TIME* magazine.[1] It proclaims, under the picture of Einstein, in bold-face letters the message: EVERYTHING IS RELATIVE. The basic rule in advertising, it is well to recall, is a reliance on commonly accepted beliefs, on generally shared cravings, hopes, and fears, or, in short, on the prevailing climate of thought.

The claim that something absolute may be lurking beneath relativity theory, may therefore be surprising, though not original at all. That Einstein's Relativity Theory implies elements and considerations that are absolutist in character was voiced by Planck as early as 1924 in an address "From the Relative to the Absolute,"[2] which quickly acquired world-wide publicity. Somewhat earlier Einstein himself began to make statements about the indispensability of metaphysics[3] which gave no comfort to positivists and empiricists, so many supporters of the view, in one sense or another, that there is nothing absolute and that therefore everything is relative. It could not have therefore come as a surprise to Philipp Frank that, as he lectured on relativity at the meeting in Prague of German physicists in 1929, a participant publicly warned him about the absolutist character of Einstein's ideas.[4] Frank refused to take heed for the rest of his life. The main proof of this is Frank's *Relativity—A Richer Truth*, a book distinctly insensitive to the perspective in which Einstein viewed relativity in particular and the philosophy of physics in general.[5]

The essence of that warning given at that Congress to Frank was that Einstein fully agreed with Planck that physical laws describe a reality which is independent of the perceiving subject. Doubts on that point were no longer permissible in 1931 when there appeared in print Einstein's contribution to the Maxwell commemorative volume, a contribution which began with the famous declaration: "Belief in an external world independent of the perceiving subject is the basis of all natural science."[6] Twenty years later, when the Vienna Circle regrouped itself in the United States, renewed efforts were made by spokesmen of the Circle, such as Reichenbach, to elicit a word or two from Einstein on behalf of their own "relativist" interpretation of Einstein's relativity. Einstein did not encourage them, though being aware that in turn, as he put it, they would charge him with the "original sin of metaphysics."[7] In his last essay on relativity, written in 1950, Einstein stated nothing less than that every true theorist was

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a tamed metaphysician, no matter how pure a positivist he fancied himself.[8]

In all these statements Einstein denounced positivism, endorsed a realist metaphysics, and professed his belief in the objectivity of physical reality. These statements (and many others that cannot be quoted here) were so many public and emphatic indications of his belief that there was something absolute beneath the relative. Yet, one would look in vain for any substantive trace of those statements in the books and articles written on relativity by Frank, Carnap, Reichenbach, Feigl, all members of the Vienna Circle, who in the 1950s and 1960s captured, in the USA at least, the role of authoritative spokesmen on behalf of Einstein in particular and of science in general. Their systematic silence on many a relevant statement and fact was only part of the strategy pursued by them. Instead of strategy, the word crusade would be more appropriate. Reichenbach himself warned that logical positivism should be looked upon as a crusade and not as an abstract philosophizing.[9] Intellectual crusades have their inner logic to which logical positivists were not immune. Or, as Herbert Feigl admitted well over a decade ago: "Confession, it is said, is good for the soul. Undoubtedly we [logical positivists] made up some facts of scientific history to suit our theories."[10]

Such a confession, rather incriminating for positivists, logical or other, who profess to be respectful only of facts, is hardly a spontaneous one. It is most likely triggered when a carefully contrived and nurtured make-believe or illusion is suddenly punctured. As to the long-cherished balloon of Einstein's positivism, it received a particularly stinging blow through the publication, in 1968 and 1969, respectively, of two extensive studies by Prof. G. Holton, "Mach, Einstein, and the Search for Reality," and "Einstein, Michelson, and the Crucial Experiment."[11] Neither of these massively documented essays is without some shortcoming. Although in Einstein's formulation of special relativity the experiment of Michelson and other experiments devised for the detection of the ether played no crucial role, they were familiar to Einstein and played some role in his reasoning. As to Einstein's departure from and opposition to Mach concerning reality, Holton did not quote two letters of Einstein which are particularly expressive in this respect and will be discussed later.

It would be rather naive to assume that such and similar documentations, nay Einstein's own statements repeated over four decades, would be effective in discrediting the climate of thought in which an allegedly exclusive respect for facts supports the tenet according to which everything is relative, and especially all values are relative. The ludicrous worshiping of "facts alone" and its invitation to unabashed selfishness, if not dishonesty, once the concomitant relativization of values is made full advantage of, were already immortalized in Dickens' *Hard Times*. Clearly, the climate of thought in question had existed long before Einstein's relativity was cited on its behalf. Of the long story of the relativization of truth and values in Western thought, let it suffice here to note that pragmatism and behaviorism were catchwords for a long time before it became fashionable to justify them with copious references to a theory of physics, known as relativity.[12] A striking illustration of the relativization of truth and values as it asserts itself in our own days is that "crazy quilt of revised judgments"—the concise summary by an anonymous reviewer of the picture which emerges from a recent survey of textbooks on American history. Not that Frances Fitzgerald, the author of that survey,[13] is particularly happy with the systematic discrediting of traditionally shared views on the foundation and purpose of this nation of ours. But she offers a very revealing justification of this unpleasant process: "All of us children of the twentieth century know or should know that there are no absolutes in human affairs." She also specifies the source of this knowledge as "the pluralism or relativization of values."[14]

It is a redeeming value of her reasoning that she does not invoke Einstein's relativity

as a support, a surprising departure from a standard technique. That the technique is such a standard can be gathered from that advertisement in *TIME* which also offered as an unquestioned verity that "In the cool beautiful language of mathematics, Einstein demonstrated that we live in a world of relative values." The statement is as misleading as almost anything that makes for flashy advertisement, but, as all such advertisement, it reflects a tone of thought, or at least an unconscious wishful thinking—otherwise it would not have been seized upon by a highly professional advertising agency.[15] Interested in quick profit, such agencies are not the ones to ask whether indeed Einstein had ever tried to prove in the language of mathematics, or in any language, that all values are relative.

To find the answer to this question a few hours of reading of Einstein essays, or a consultation with anyone familiar with his writings and not blinded by positivism, would have been sufficient. Einstein never tried such a demonstration and certainly not in the cool and beautiful language of mathematics. This is not to suggest that Einstein offered no clues to his own thinking about values or that he was original or consistent in this respect. He merely voiced an old cliché when in the Foreword which he volunteered to Frank's *Relativity—A Richer Truth* he specified man's instinctive avoidance of pain as *the* source of value judgments and of ethics itself. On this basis the relativity of values could only be a foregone conclusion.[16] It is, of course, well known that for all his dismissal of religion and of belief in a personal God, Einstein insisted on the unquestionable superiority of the Judeo-Christian perspective in which unconditional value is attributed to each and every human being. But his insistence was incompatible with mechanistic evolutionism which he also endorsed, although it provides, as had already been pointed out by such a protagonist of Darwin as T.H. Huxley, no room for "higher" and "lower."[17]

To his credit, Einstein consistently avoided basing his views on values and ethics on his theory of relativity and on mathematics. This shows something of his instinctive greatness, because history knows of some misguided men of science (Maupertuis and Condorcet, for instance) who tried to construe ethical theories from manipulating quantities.[18] As to his own theories, which, as will be seen, were more than mere mathematics, he stated emphatically four years before his death: "I have never obtained any ethical value from my scientific work."[19] To be sure, he made a few memorable utterances concerning freedom and oppression, but his general trend was to avoid involvement in human affairs. He declined the presidency of Israel with a reference to his lack of familiarity with personalities and society. Tellingly, his autobiography opens with the remark that he had never regretted that he had left behind the customary human world and moved into the strange, depersonalized world of science.[20]

Clearly, "the absolute beneath the relative" should, in connection with Einstein's theories, be sought in a direction different from what leads to values and ethics. Of the three main theories of Einstein—Special Relativity, General Relativity and Unified Field Theory—the first, on a cursory look at least, does not give a clue as to what the direction might be. The article in which Einstein formulated Special Relativity in 1905 has become the victim of a stereotyped reading. In the crudely superficial version of that reading, Special Relativity is an effort to explain the Michelson-Morley experiment. According to the moderately superficial version, Special Relativity "has its roots in the questions: Where are we? How are we moving?" An example of this latter version is the article "Relativity" by B. Hoffmann in the *Dictionary of the History of Ideas*, an article which starts with the foregoing questions.[21] Both readings can claim for their support one and the same phrase which, after a reference to electromagnetic induction and to the unsuccessful attempts to discover any motion of the earth relative to the ether, sug-

gests that "the phenomena of electrodynamics as well as of mechanics possess no properties corresponding to the idea of absolute rest."[22] However, the explanation of the unsuccessful attempts had already been given by the Lorentz transforms and by the contraction postulated by FitzGerald. As to the absolute rest, its critique had already been offered two hundred years earlier by Berkeley on purely kinematic grounds. There had to be some specific and novel rationale in Einstein's handling two well-worn topics. The clue of this is given in the phrase which immediately follows the one just quoted above. There Einstein goes beyond the question of absolute rest with the remark that the null-results of those experiments rather suggest that "the same laws of electrodynamics and optics will be valid for all frames of reference for which the equations of mechanics hold good."

In itself the phrase is rather ambiguous: in the light of Einstein's train of thought leading to General Relativity and to Unified Field Theory, the phrase is a classic of the inability of a genius to say explicitly what was truly in the back of his mind. Had Einstein italicized the word *same*, he would have strongly intimated that his principal concern was neither the explanation of the Michelson-Morley experiment, nor the problematic character of absolute rest. It was rather the *sameness* of the laws of electrodynamics, which the opening phrase of Einstein pointedly introduced as "Maxwell's electrodynamics." This electrodynamics had a special place in Einstein's thought. In his autobiography he referred to it as the "most fascinating subject" available in his student days.[23] Actually, he viewed it as the most fundamental subject in physics. The proof of this is his contribution in 1931 to the volume commemorating the centenary of Maxwell's birth. There, in surveying the latest developments of physical theory, including quantum mechanics, he claimed it as a certainty that ultimately physics will return to carrying out "the program which may properly be called as the Maxwellian—namely, the description of physical reality in terms of fields, which satisfy partial differential equations without singularities."[24]

The singularities implied by the context were the material points (particles) which in Newton's physics represented the bedrock of reality. They were replaced by fields in Maxwell's theory which, of course, did not mean the elimination of such singularities as constants and boundary conditions. But the notion of a field could not function as the post-Newtonian foundation of physics if it was the function of a particular frame of reference. Its independence of any frame of reference could only be safeguarded if Maxwell's equation retained the same form regardless of the frame of reference in consideration. This, however, implied the postulate of the constancy of the speed of light regardless of the motion of its source. Such is the ultimate justification of that postulate about which Einstein felt it necessary to note in his 1905 paper that it was "only apparently irreconcilable with the former" principle, which he unfortunately labeled "Principle of Relativity." The label, perhaps the most unfortunate in the entire history of physics, made him oblivious to the fact that he failed to reconcile fully two apparently contradictory points. One was the principle itself, which on a cursory look stated the relativity of all positions and motions. The other was the speed of light, endowed, as being not relative to the motion of its source, with an absolute character. His claim that between these two points there was no basic irreconcilability made sense only if the expression "same laws of electrodynamics" meant the sameness of these laws in a somewhat different but certainly far deeper sense. He should have spelled out that if those laws retained their original form regardless of the frame of reference to which they were related, it was only because they reflected an objective, invariant, absolute cosmic order and reality.

Such was the gist of Einstein's explanation of Lorentz's equations, which had already explained the null result of the Michelson-Morley experiment, but through which (and this was the all-important point not em-

phasized by Lorentz) Maxwell's equations retained the same form even when related to a frame of reference which moved at constant velocity with respect to another. That in 1905 Einstein himself was not entirely clear or explicit as to what was the real driving force behind his reasoning, is a secondary matter.[25] The important thing is that his mind was in the grip of that driving force. It was the attractiveness of a specific vision of nature and of a most fruitful scientific interpretation of it.

The vision was that of a cosmic reality, fully coherent, unified and simple, existing independently of the observer, that is, not relative to him, and yielding its secrets in the measure in which the mathematical formulae through which it was investigated, embodied unifying power and simplicity. In the case of Special Relativity there was already a most unexpected and unintended yield, the absolute energy content of a mass at rest, given in the now historic formula $E=mc^2$.[26] Although at that time experimental evidence on behalf of that formula was ambiguous, Einstein upheld its validity by referring to the broad theoretical foundation on which it rested. The foundation was much broader than it appeared to be. The proof of this is his first essay on General Relativity, running over fifty pages, which was already in print in 1907.[27] Clearly, if Special Relativity had not been far more than the explanation of the null result of the Michelson-Morley experiment and an answer to the questions of where we are and how we move, Einstein would not have faced up to the problems of General Relativity while the printer's ink was still fresh on his Special Relativity. His real concern was the elaboration of a cosmic view in which physical reality was a totality of consistently interacting things, an absolute in the sense that its existence was not relative to any observer, and absolute also in the sense that if the observer's knowledge of reality was properly scientific, the laws in question had to remain as invariant as the universe is invariant. Indeed, Einstein himself suggested that Special Relativity should have been called the theory of invariance. On the face of it, General Relativity is a further exercise in relativization. The impossibility of specifying any frame of reference as privileged over any other that move with respect to one another with constant velocity is extended in General Relativity to all frames of reference that are accelerated with respect to one another. The three classic observational consequences of General Relativity (the gravitational redshift, the gravitational bending of light, and the precession of the perihelion of planetary orbits, observable in the case of Mercury) implied not only relativization but also equivalence or unification, namely, the equivalence of gravitational and inertial masses. That the thrust of General Relativity was indeed unification became all too obvious with the appearance in 1917 of the paper, "Cosmological Considerations on the General Theory of Relativity."[28] Instead of 'considerations' Einstein should have perhaps written 'consideration.' The considerations he specified (the value of the total mass of the gravitationally interacting matter, the value of the radius of that totality, or the universe, the curvature of space-time) are well known. What is hardly ever recalled is the fact that all such considerations rest on one basic consideration: the power or ability of General Relativity to treat in a scientifically consistent manner the totality of material particles endowed with gravitation. That ability made scientific cosmology possible for the first time.

There were, of course, cosmologies before Einstein. Their scientific insignificance is not primarily the outcome of the relatively meager data that were available about the cosmos prior to the twentieth century. What makes those pre-Einstein cosmologies scientifically insignificant is that (with the exception of one proposed by Lambert) they were not free of a basic theoretical defect of which there was a sufficient awareness already in Newton's time. The defect concerns the infinity paradox which plagued the notion of the idea of an infinite universe whether it was homogeneous or hierarchical. The idea of a homogeneous infinite universe is usually

connected with Newton's name. The basis of this connection is that the idea began to be mentioned by some scientists only from his time on. Although Newton, as it appears from his letters to Bentley, did not seem to think that an infinite homogeneous universe of stars is gravitationally impossible, he never departed from his early belief that the universe is finite whereas space itself was infinite.[29] Indeed, no protest was heard either from Newton or from others when in 1714 Addison attributed to Newton this idea of a finite universe in infinite space and praised it as the notion most worthy of reason and of God. Addison did so in the pages of the *Spectator*[30] which was read all over Europe.

Contrary to clichés in most histories of cosmology and science, the finiteness of the universe was the prevailing view until the early part of the nineteenth century. But as Lambert already pointed out in 1761, such a finite universe had to collapse gravitationally unless all its parts revolved around a center, possibly an enormously massive body. The rotating finite universe proposed by Lambert was hierarchically organized,[31] an organization which had already been proposed by Kant a few years earlier who argued the infinity of a hierarchically organized universe without realizing that his universe had to have an infinitely massive body at its center.[32] Earlier, Halley tried to save the infinity of the universe by suggesting that the distribution of stars was not homogeneous.[33] He considered only the optical problem but not the gravitational one. In 1823 Olbers notoriously failed to consider the gravitational paradox as he tried to solve the optical paradox by a recourse to the absorption of starlight in interstellar space,[34] a procedure already suggested in 1731 by Hartsoeker,[35] and in 1743 by Chéseaux.[36]

There was no echo when in 1872 Zöllner showed both that an infinite homogeneous universe was contradictory and that the only consistent way of treating the totality of gravitationally interacting matter was to take it to be finite in a four-dimensional non-Euclidean space. No major discussion followed when in 1895 Seeliger suggested a change in the inverse square law of gravitation to avoid the gravitational contradiction which arises in an infinite homogeneous universe. Needless to say, the slightest change in the inverse square law made impossible the explanation of planetary motions. In 1901 Kelvin summed up the paradox of an infinite universe in a concise formula, but he skirted the gravitational aspect and solved the optical aspect on the ground that the light coming from beyond the Milky Way was wholly negligible.[37] No discussion ensued when Charlier tried to save infinity in 1911 by assigning a hierarchical structure to the universe.

What these glimpses into pre-Einsteinian cosmology should suggest is that glaringly defective arguments were taken in stride as long as they were proposed in defense of the infinity of matter or space or both. Clearly, behind this non-scientific attitude there must have been lying some non-scientific motivations. They derived from the fact that it was tempting to take infinite homogeneity as a necessary form of existence, that is, something which explained itself and was its own sufficient raison d'être. The shock therefore was considerable when in 1922 Einstein emphatically argued at the Sorbonne on behalf of the finiteness of the total mass of the universe.[38] Further refinements of estimates of the average density of matter, which calls for that finiteness of the total mass, did not fail to corroborate Einstein's argument. Einstein, of course, was fully aware that it was possible to construct four-dimensional world models that could accommodate an infinite amount of matter, and even with a homogeneous distribution. Einstein, however, brushed aside these models as insignificant, although he himself devised one, according to which the world lines were helically cylindrical.[39]

A universe embodying three-dimensional Euclidean homogeneity appears so natural to perception as to be taken for a natural or necessary form of material existence. A universe resembling either a spherical cylinder or hyperbolic surface, open-ended as they could be, must strike one as very

specific and hardly a necessary form of existence. When faced with such a singular form of existence, one can hardly avoid facing up to the question: What makes the universe so specific? Of course, the universe need not be cylindrical in order to prompt this question. It is enough to think of the value of the space-time curvature which the universe actually has. It is a strange specific number, different from 0 which is the curvature of the intrinsically impossible homogeneous Euclidean universe. This 0 is a symbolic indication that such a universe, like 0, is a figment of imagination, bordering on mere nothing. A positive number, such as 0.8 or 1.6, standing for the space-time curvature, must strike one very differently. Looking at such a curvature should do what is done by a look at the tag of a dress, a tag carrying the measurement and price of the dress. Such a tag cannot help evoke the existence of a dressmaker.

Einstein himself was prompted to such considerations. His General Relativity, as the first consistently scientific treatment of the universe as the totality of gravitationally interacting entities, reassured him in his previous instinctive conviction that the universe was real and fully rational. This was one of the reasons why he rejected the philosophy of Kant for whom the notion of the universe was merely a bastard product of the metaphysical cravings of the intellect. Once the notion of the universe was made out to be intrinsically unreliable, Kant could argue that any step from the universe to the Creator was also unreliable. But once the notion of the universe was fully vindicated by General Relativity, Kant's argument and his whole criticism of natural theology lost whatever credibility it could marshal.[40] Einstein was most conscious of the full force of this implication. In a letter written four years before his death to his life-long friend M. Solovine, Einstein insisted that it was not permissible to go beyond the universe to its Creator. The letter was a reassurance given by Einstein to Solovine that Einstein, the cosmologist, had not become a believer in a personal God and Creator. He foresaw that his cosmology would be exploited by priests and theologians. "It cannot be helped," Einstien wrote to Solovine. "I add this," Einstein continued, "lest you think that weakened by old age I have fallen into the hands of priests."[41]

Once the universe as a totality of consistently interacting things is recognized as such, all efforts to relativize everything reveal their futility at once. Tellingly, the most convincing proof of that totality, the 3° K cosmic background radiation, has reminded many experts on relativity that the expansion of the universe was a non-relativist frame of reference.[42] At any rate, if not priests, at least some basic aspects of their theology must have been in the back of Einstein's mind for a reason relating to his efforts to work out a Unified Field Theory. Twice, in the late 1920s and late 1940s, Einstein thought that he had achieved his goal. As is well known, he failed in both cases. But even if he had succeeded, only gravitation and electromagnetism would have been united and only on the macroscopic level. He did not think that Relativity and Quantum Theory could be united, except by replacing Quantum Theory with something else. He never worked on nuclear forces and was dead by the time the so-called weak forces came to be widely recognized. But with his Unified Field Theory he made a most notable effort toward a goal which has lately exerted a special fascination on cosmologists.[44] The goal is the demonstration on theoretical grounds (mathematical and philosophical) that the universe (from atoms to galaxies) can only be what it is and nothing else. Einstein himself dreamed of a unified theory so simple that even the good Lord would not have been able to fashion the world along any other lines.

To his credit, Einstein never entirely parted with the humble recognition that the ultimate word in science belongs to facts, that is, to the observational verification of theories. Indeed, he did say around 1920 that if only one of the three classic proofs of General Relativity were to be disproved all General Relativity would turn into "mere

dust and ashes."[45] Others, Eddington for instance, who were animated by the vision of a final theory, were not so mindful of the primacy of facts. A scientist is hardly mindful of facts when he declares before an audience of 3000 that within a few years, but certainly sooner or later, he or others will come up with a theory which shows why the family of elementary particles and therefore the universe can only be what it is and nothing else.[46] A mere recall of the fact that science can never be sure that it knows all the facts should suffice to dispose of such a brash dream. The intrinsic merits of the goal of devising an ultimate theory should also seem nil as long as the theory is sufficiently mathematical, and clearly such a theory must be highly mathematical. Now Gödel's incompleteness theorem states that the proof of consistency of any non-trivial set of mathematical axioms can be found only outside that set, and in that sense no mathematical system can be an ultimate system. In other words, whereas General Relativity forces us to admit the realistic character of the notion of consistently interacting things, as a valid object of scientific cosmology, the application of Gödel's theorem to cosmology shows that a disproof of the contingency of the universe is impossible. The mental road to the extracosmic Absolute remains therefore fully open.

These points have been repeatedly made in several of my publications since 1966.[47] Apparently some in the scientific and philosophical community want to learn only what they want to hear, and therefore choose to ignore the tie between Gödel's theorem and cosmology. It is, of course, no surprise to me that the contingency of the universe is not pleasant news to a scientific humanism which claims that man is a mere accident, in no way subject to something transcendental to the entire universe. Such a humanism is more powerful in our times than it has ever been. This is why *TIME* felt it natural to proclaim under Einstein's picture that everything is relative. The only message befitting Einstein's picture would have been a warning that the absolute is lurking everywhere beneath the relative. But *TIME* is very human and so are our times, indeed all times. To this rather defective humanness of the times proper reflections on Einstein's work may bring a much needed corrective. Failing that, there will be no slowing down of that culturally destructive merry-go-round which witnesses the absolutization of the relative by those who are busy relativizing the absolute.

1. The advertisement, facing page 64, was on behalf of *TIME* itself.
2. The address, "Vom Relativen zum Absoluten," has been a part of the best known collection of Planck's addresses, *Wege zur physikalischen Erkenntnis: Reden und Vorträge*, from its first edition (1933) on. A somewhat free English version is available in M. Planck, *Where is Science Going?* (New York: W.W. Norton, 1932), 170-200. In that address Planck emphasized the absolute value of energy in terms of the formula $E=mc^2$ and the independence of the total four-dimensional space-time manifold from the observer.
3. See G. Holton, "Mach, Einstein, and the Search for Reality" (1968), in *Thematic Origins of Scientific Thought* (Cambridge, Mass.: Harvard University Press, 1973), 243.
4. Reported by Frank himself in *Einstein: His Life and Times* (New York: A. Knopf, 1947), 215.
5. London: Jonathan Cape, 1951. The book certainly reveals the futility of the efforts of a pragmatist to vindicate universal validity for a democratic way of life on the basis of the "relativity of knowledge." The offsprings of that relativity were, according to Frank, "not only modern science, but also liberal Christianity and reformed Judaism" (20), a statement which gives away its true character to anyone mindful of the chronic inability of both liberal Christianity and of Reformed Judaism to proclaim anything absolute.
6. A. Einstein, *The World as I See It* (New York: Covici-Friede, 1934), 60.
7. See his "Reply to Criticisms," in P.A. Schilpp, ed., *Albert Einstein: Philosopher-Scientist* (Evanston: Library of Living Philosophers, 1949), 673.
8. "On the Generalized Theory of Gravitation," in *Ideas and Opinions by Albert Einstein* (New York: Crown, 1954), 342.

9. "The whole movement of scientific philosophy is a crusade . . . . What I'm doing aims as directly at social consequences as the programs of those who call themselves 'social reformers'." Statement reported by C. Schuster in M. Reichenbach and R.S. Cohen, eds., *Hans Reichenbach: Selected Writings, 1909-1953* (Dordrecht: D. Reidel, 1978), 1:56-57.

10. H. Feigl, "Beyond Peaceful Coexistence," in R.H. Stuewer, ed., *Historical and Philosophical Perspectives of Science* (Minneapolis: University of Minnesota Press, 1970), 3.

11. The latter too is reprinted in Holton's *Thematic Origins of Scientific Thought*, 261-352.

12. Relativity was still a novelty for many a physicist in the 1920s, which saw the publication of *Relativity in Man and Society* (New York: G.P. Putnam's Sons, 1926) by A. Bentley, with its ch. 2, entitled: "The Term 'Einstein'—Its Meanings." The next two books, though separated by a World War, a continent, and opposite theses, have one small but revealing detail in common. In his *In Quest of Morals* (Stanford University Press, 1941), H. Lanz quotes (19) H. Weyl on behalf of his claim that relativity supports philosophical and ethical relativism, who is also quoted, but in the opposite sense, in H. Wein's *Das Problem des Relativismus* (Berlin: W. De Gruyter, 1950), 26. No relevance is accorded to relativity (and no mention of Einstein is made) in three epistemological rebuttals of relativism: G. Rabeau, *Réalité et relativité* (Paris: Marcel Rivière, 1927); H. Spiegelberg, *Antirelativismus* (Zurich: Max Niehans, 1935); G.D. Kaufmann, *Relativism, Knowledge and Faith* (Chicago: University of Chicago Press, 1960). The following two books are relevant also because of the title of this essay. In *Relativisme* (Paris: Kra, 1930), a little known work by A. Maurois, there is a chapter, "L'Absolu dans le relatif" (69-76), devoted to the impossibility of "complete" relativism, though with no reference to Einstein or relativity. Both Einstein and relativity are prominently in view from the very start in *Il n'y a d'absolu que dans le relatif* (Paris: J. Vrin, 1975) by R. Levi.

13. *TIME*, Sept. 10, 1979: 68, in a review of *America Revised: History Schoolbooks in the Twentieth Century* (New York: Little, 1979) by Frances Fitzgerald.

14. *Ibid.*, 69.

15. That such is the case is palpably shown by another full-page advertisement on behalf of *TIME* (Nov. 12, 1979: 124) which, under the picture of two famous ballet dancers, carries the caption: "News, like beauty, is often in the eye of the beholder."

16. Einstein was not unaware of this possibility, but to make matters worse, he tried to save the norms of ethics from pure arbitrariness with a reference to "the psychological and genetic point of view." *Out of My Later Years*, (New York: Philosophical Library, 1950) 110. In doing so he only presented himself as an easy target to any skillful debater who has been granted the basic philosophical premises of Darwinism.

17. See *More Letters of Charles Darwin: A Record of His Work in a Series of Hitherto Unpublished Letters*, ed. F. Darwin and A.C. Seward (New York: D. Appleton, 1903) 1:360.

18. For details, see my *The Relevance of Physics* (Chicago: University of Chicago Press, 1966), 376-78.

19. Quoted in P. Michelmore, *Einstein, Profile of the Man* (New York: Dodd, 1962), 251.

20. *Albert Einstein: Philosopher-Scientist*, 5.

21. New York: Charles Scribner and Sons, 1968-74; 3:74.

22. "On the Electrodynamics of Moving Bodies," in *The Principle of Relativity: A Collection of Original Memoirs on the Special and General Theory of Relativity by H.A. Lorentz, A. Einstein, H. Minkowski and H. Weyl*, with notes by A. Sommerfeld, translated by W. Perrett and G.B. Jeffrey (1923; New York: Dover, n.d.), 37-38.

23. *Albert Einstein: Philosopher-Scientist*, 33.

24. "Clerk Maxwell's Influence on the Evolution of the Idea of Physical Reality," in A. Einstein, *The World as I See It*, 66.

25. Inattention to this point lies at the root of that controversial chapter on relativity in E.T. Whittaker's *A History of the Theories of Aether and Electricity, Volume Two: The Modern Theories 1900-1926* (London: Thomas Nelson, 1953), 27-77, in which Einstein appears a minor figure in comparison with Poincaré and Lorentz.

26. After writing in 1905 the energy content of a mass as being equal to L/c^2 and in 1906 as E/V^2, he finally put in 1907 the energy E as being equal to $_{\mu}c^2$, still not exactly the now standard notation.

27. "Ueber das Relativitätsprinzip und die aus demselben gezogenen Folgerungen," *Jahrbuch der Radioaktivität und Elektronik* 4 (1907): 411-62.

28. *The Principle of Relativity*, 177-88.

29. See A.R. and M.B. Hall, *Unpublished Scientific Papers of Isaac Newton* (Cambridge: Cambridge University Press, 1962), 138.

30. See the issue, July 9, 1714. An equally important witness is Voltaire in the uncounted editions of his *Elémens de la philosophie de Newton* (1738) following its enlargement with his booklet, *La métaphysique de Newton ou parallèle des sentimens de Newton et de Leibniz* (Amsterdam: chez Jacques Desbordes, 1740), in which he emphasized the infinity of space and the finiteness of matter with a reference to the authority of Newton (2).

31. Lambert did so in his *Cosmoligische Briefe*. See my translation, *Cosmological Letters on the Arrangement of the World-Edifice*, with an introduction and notes (New York: Science History Publications, 1976).

32. For details see the introduction of my translation of his *Allgemeine Naturgeschichte und Theorie des Himmels* or *Universal Natural History and Theory of the Heavens* (Edinburgh: Scottish Academic Press, 1981).

33. For a reprint of his two papers, see my *The Paradox of Olbers' Paradox* (New York: Herder and Herder, 1969), 249-52.

34. For a discussion and a reprint of his paper, see *ibid.*, 131-43 and 256-64.

35. He did so in his *Cours de physique* (The Hague: chez Jan Swart, 1730), 235.
36. For a reprint of Chéseaux's paper, see my *Paradox of Olbers' Paradox*, 253-55.
37. See my "Das Gravitations-Paradoxon des unendlichen Universums," *Sudhoffs Archiv* 63 (1979): 105-22, and my *The Milky Way: An Elusive Road for Science* (New York: Science History Publications, 1972), 275-77.
38. Typically, the French physicist, E. Borel, was willing to grant only the "convenience" of the finiteness of mass in his exposition of Einstein's theories, *L'espace et le temps* (Paris: F. Alcan, 1922). See its English translation, *Space and Time* (London: Blackie and Son, 1926), 226-27.
39. "Cosmological Considerations on the General Theory of Relativity," in *The Principle of Relativity*, 179. It should be revealing that Eddington, in his *Space, Time and Gravitation: An Outline of the General Relativity Theory* (Cambridge: Cambridge University Press, 1920) objected to Einstein's world-model on the ground that it reinstated absolute space-time (see 162)!
40. For the inconclusiveness of Kant's criticism of the cosmological argument, see my *The Road of Science and the Ways to God* (Gifford Lectures, Edinburgh, 1974-75 and 1975-76; Chicago: University of Chicago Press, 1978), 121-22 and 379-80.
41. Letter of March 30, 1952, in A. Einstein, *Lettres à Maurice Solovine*, reproduites en facsimile et traduites en français (Paris: Gauthier-Villars, 1956), 114-15. For longer excerpts in English translation from this and Einstein's preceding letter to Solovine, see my *Cosmos and Creator*, (Edinburgh: Scottish Academic Press; Chicago: Regnery-Gateway, 1980), 52-53.
42. See P.G. Bergmann, "Cosmology as a Science," in R.J. Seeger and R.S. Cohen, eds., *Philosophical Foundations of Science* (Dordrecht: D. Reidel, 1974), 181-88, who speaks of the "breakdown of the principle of relativity with respect to the background radiation" (185).
43. See my *Cosmos and Creator*, 45-48.
44. "This point [the moment of the Big Bang] is thus de facto preferred . . . . Naturally this does not constitute a disproof, but the circumstance irritates me," wrote Einstein to De Sitter on June 22, 1917. See *Nature*, Oct. 9, 1975, 454.
45. A statement made by Einstein in 1920 during a lecture given in Prague which was attended by young H. Feigl who recalled it many years later. See *Historical and Philosophical Perspectives of Science*, 9.
46. Professor Murray Gell-Mann, at the Twelfth Nobel Conference, October 6, 1976, held at Gustavus Adolphus College, St. Peter, Minnesota.
47. Such as *The Relevance of Physics*, 128-30; *The Road of Science and the Ways to God*, 456; *Cosmos and Creator*, 49-50; and "From Scientific Cosmology to a Created Universe," *Irish Astronomical Journal* 15 (March 1982): 253-62.

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